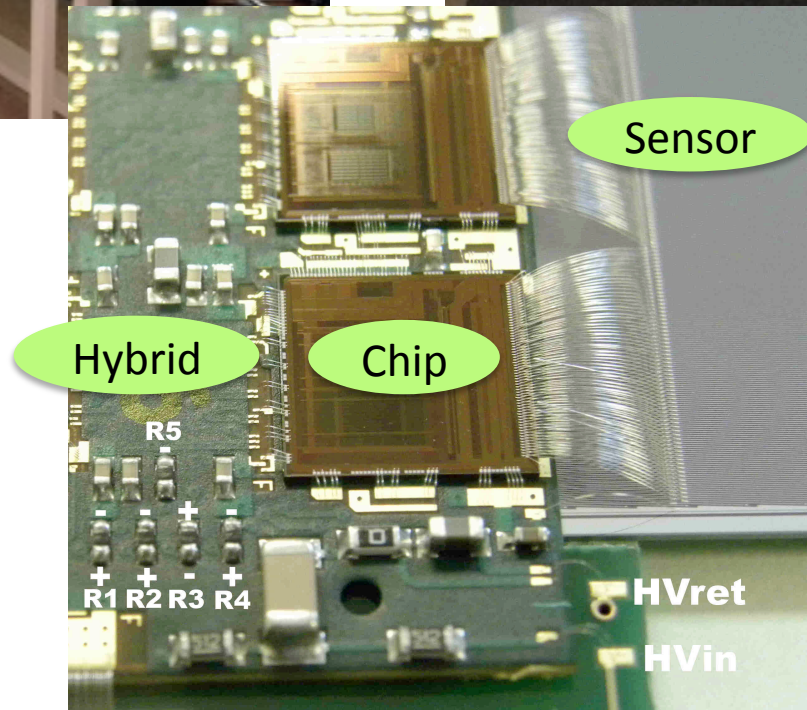
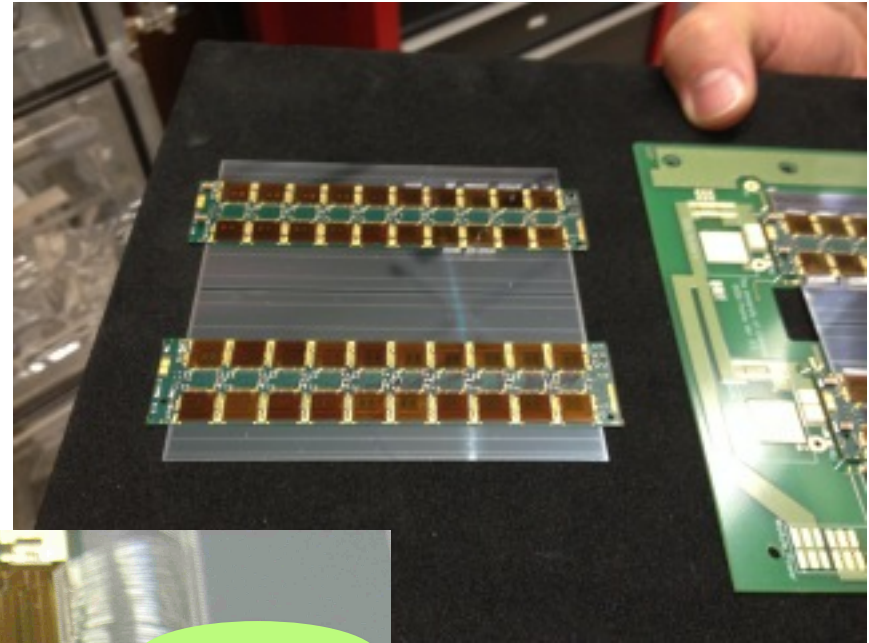


Silicon @ BNL

Jessica Metcalfe

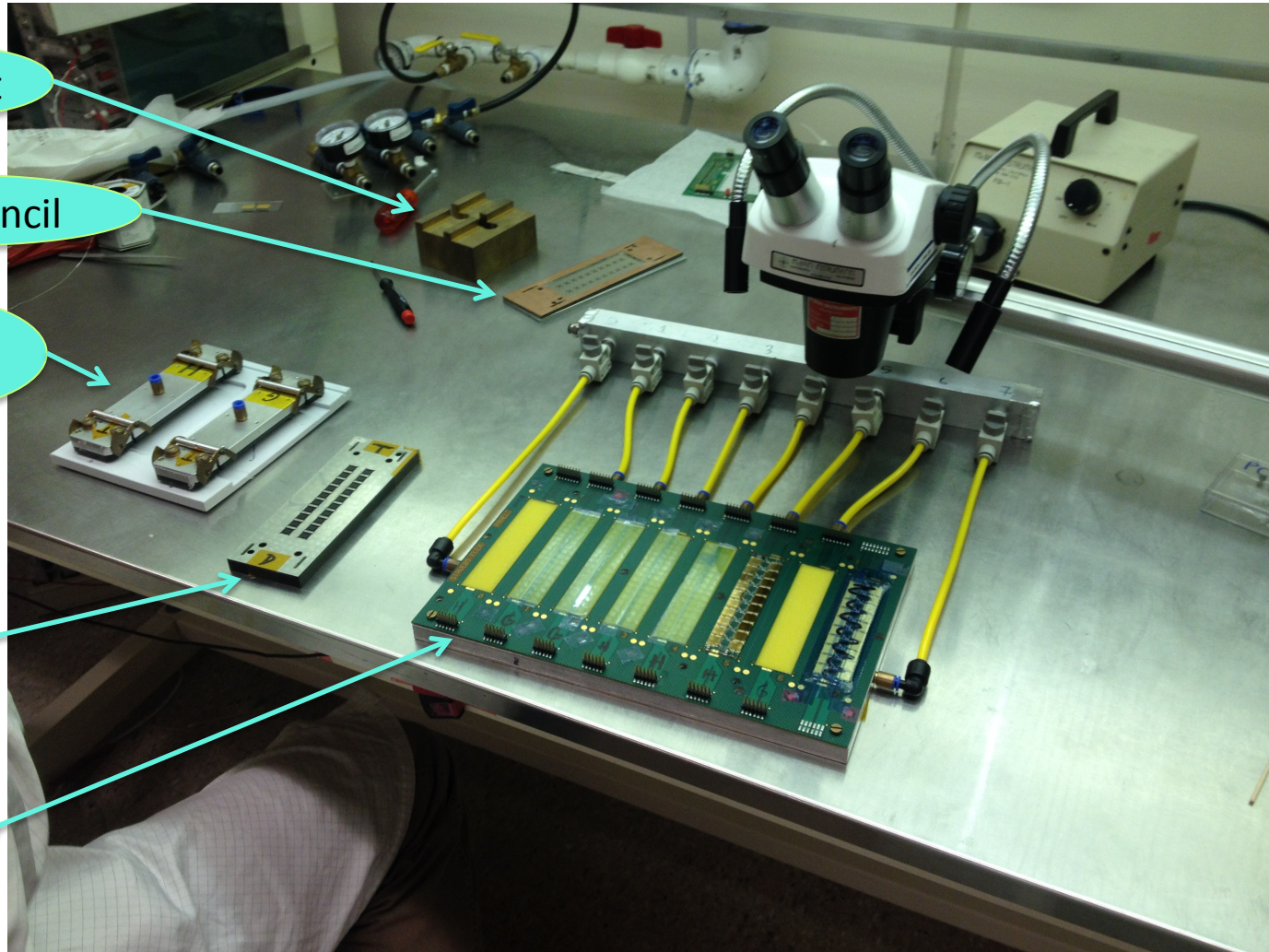
- Santa Cruz ITK strip production
- Santa Cruz HVCMOS studies
- U. Geneva HVCMOS studies
- Proposal for HVCMOS studies at BNL
- Lab Equipment

ITK Strip Production

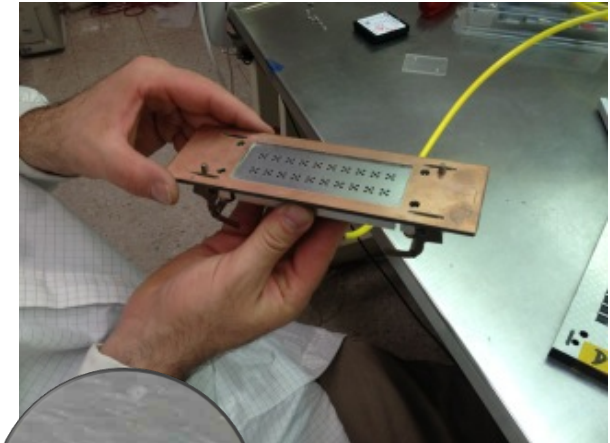
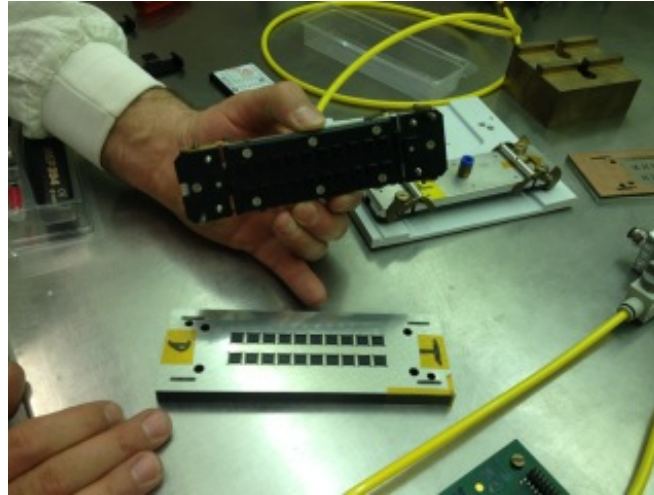


ITK Strip Production

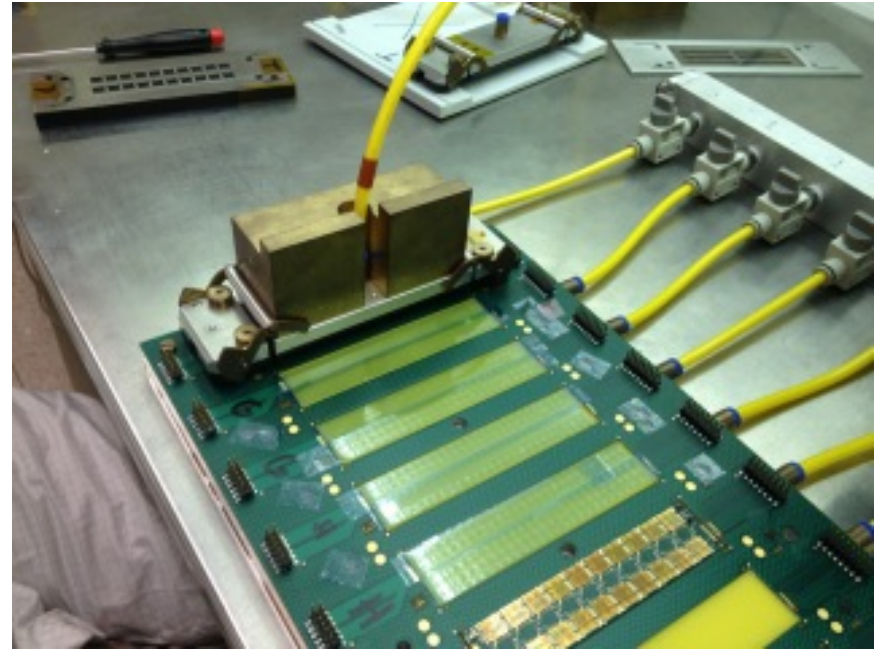
Production bench



ITK Strip Production



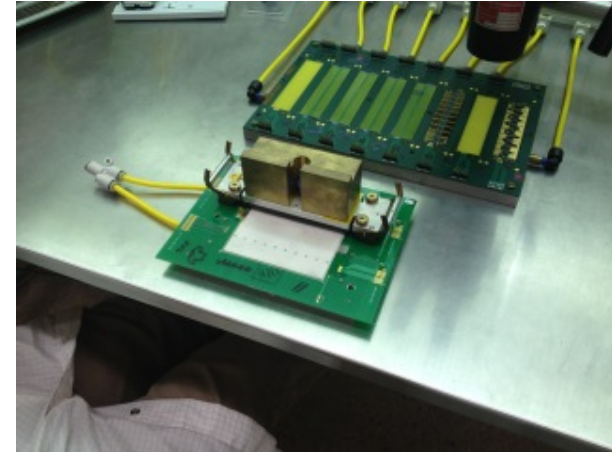
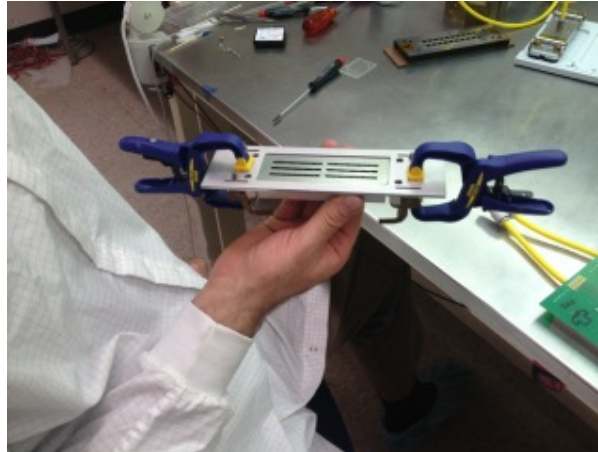
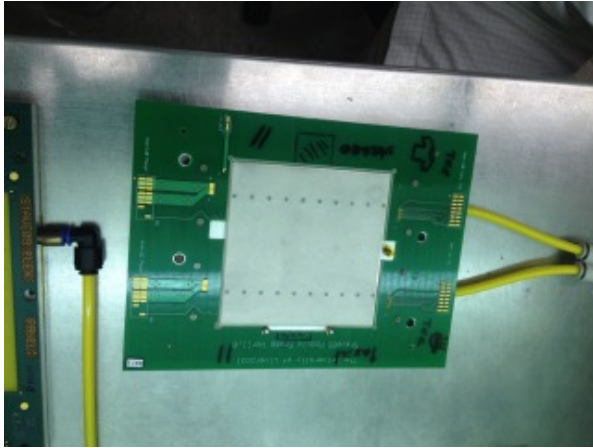
- 1) Prepare chips in jig for precision alignment
- 2) Vacuum tool to lift chips
- 3) Stencil for glue pattern on chips



- 4) Apply glue
- 5) Align chips on hybrid and set glue
 - uniformity of glue thickness is very important

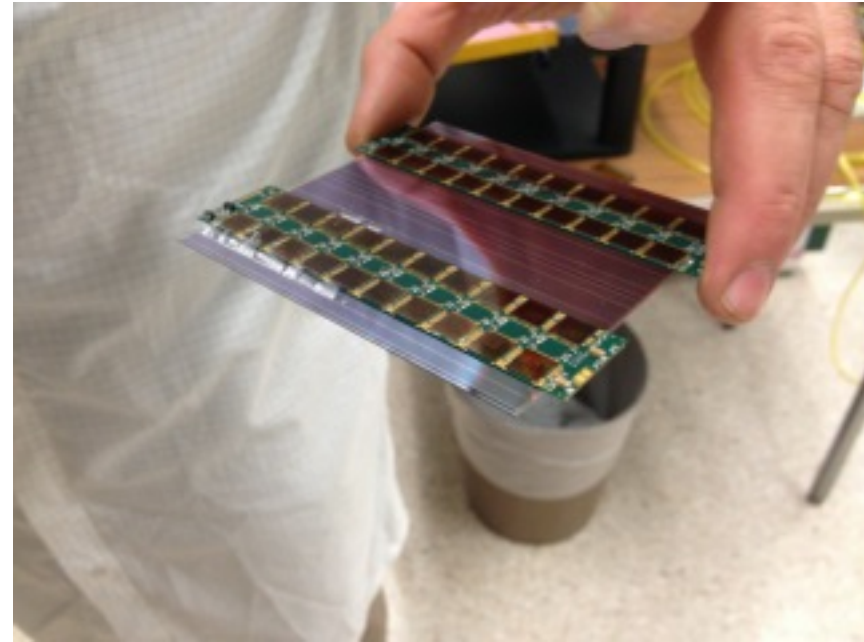
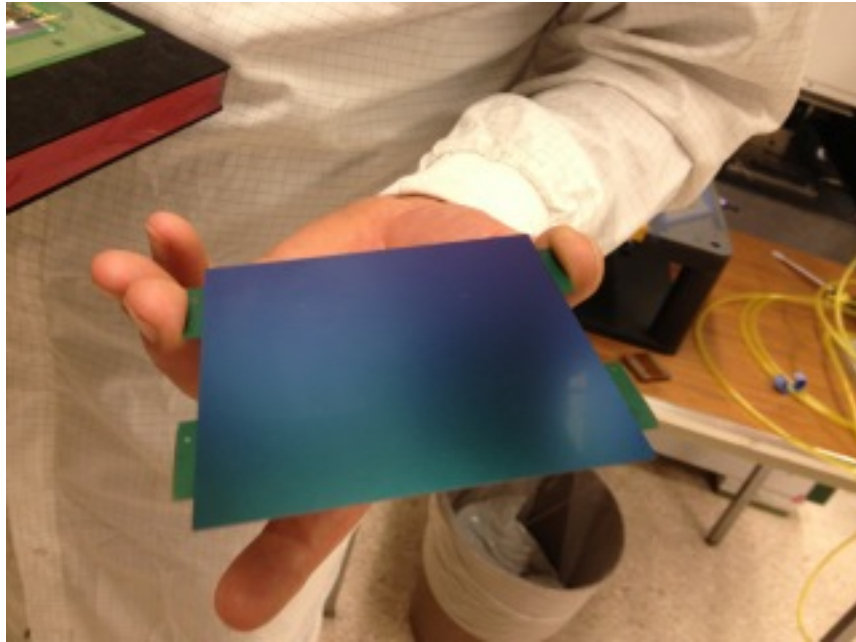
Chips are wire bonded and tested after the first gluing phase
A few wire bonds are used to connect to a test board and then later removed

ITK Strip Production



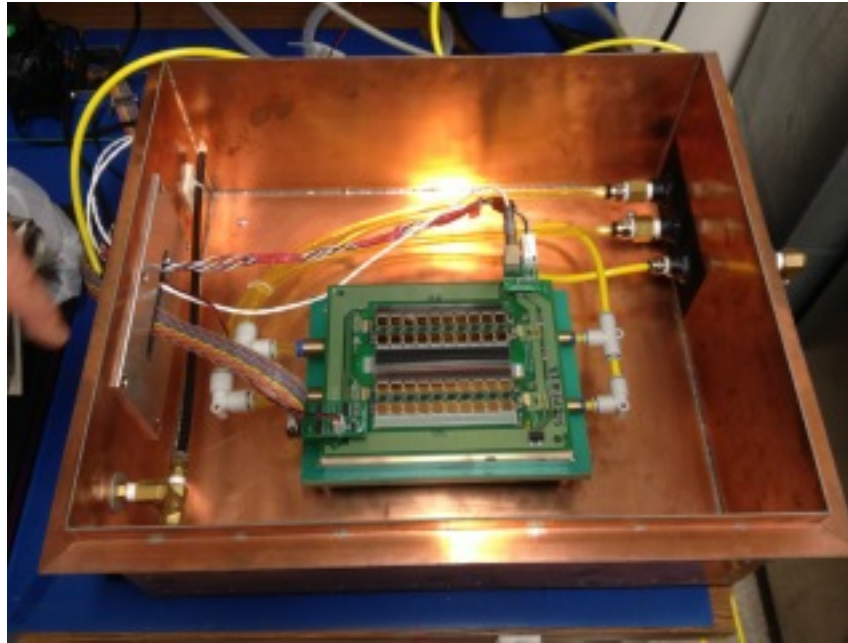
Gluing and testing process repeated for hybrid + sensor
More tests are done after second gluing phase

ITK Strip Production



Finished Sensor module

Production Module Test Station:



Light tight box
Cold vacuum chuck
Nitrogen flow
Electrical input/output connections

Read-out for Strip Modules:



HCC controller with ABC130

High Speed IO board from SLAC

(upgrade to Atlys Digilent FPGA board)

Interlock (Cambridge)

SCT DAQ software -> automatic configuration, calibration tests, etc.

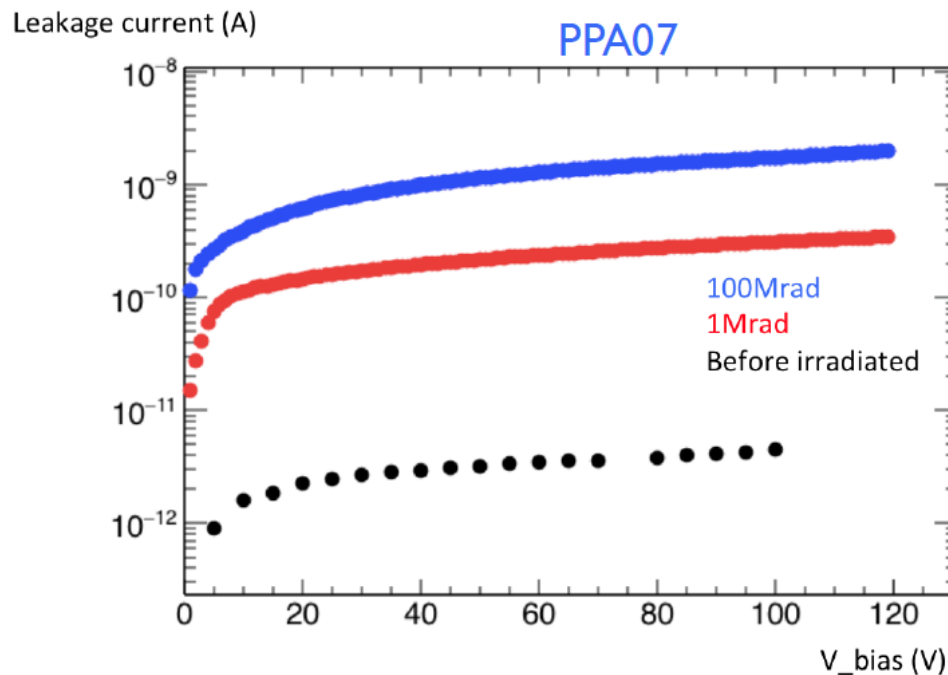
ITK Strip Measurements



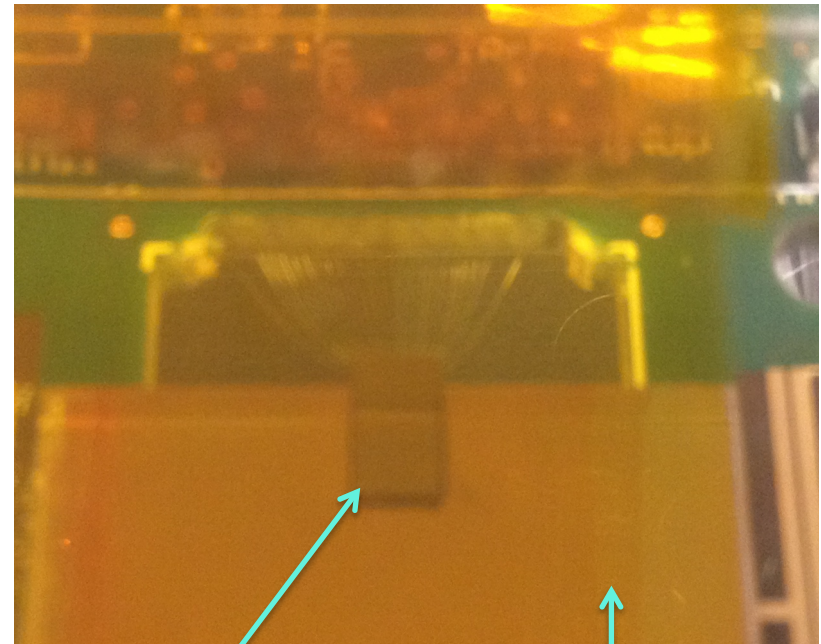
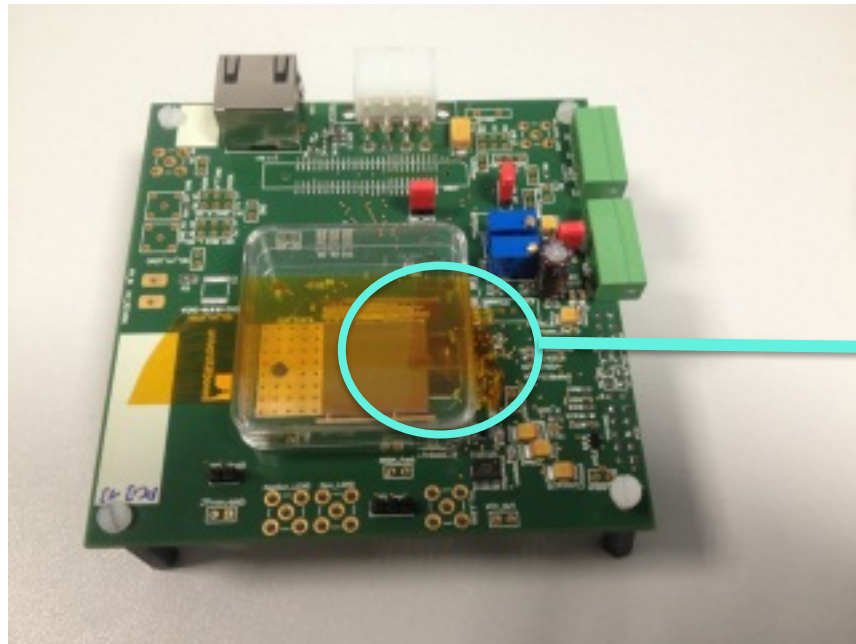
Visual inspection:
Microscope
Digital display

HVCMOS @ Santa Cruz

- Irradiation studies CHES1
 - IV curves
 - Inter-strip resistance to study bias grid effects
 - Laser injection to study signal shape



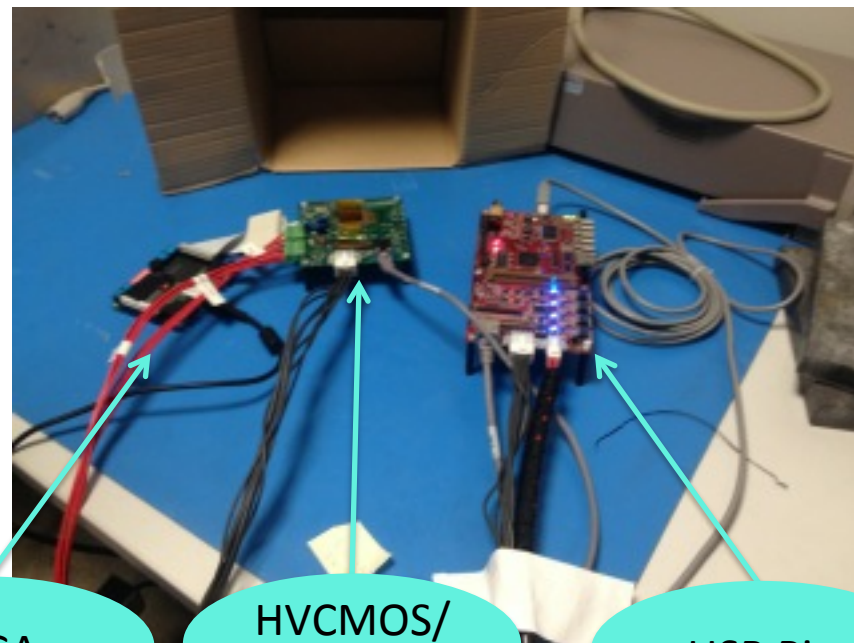
Zhijun Liang (UCSC)
[https://indico.desy.de/
conferenceDisplay.py?
confId=11834](https://indico.desy.de/conferenceDisplay.py?confId=11834)



HVCMOS

FEI4

University of Geneva @ CERN



FPGA

HVCMOS/
FEI4

USB Pix

Activities:

Threshold measurements: lowest ~500 electrons

Noise characterization

Testbeam

....more

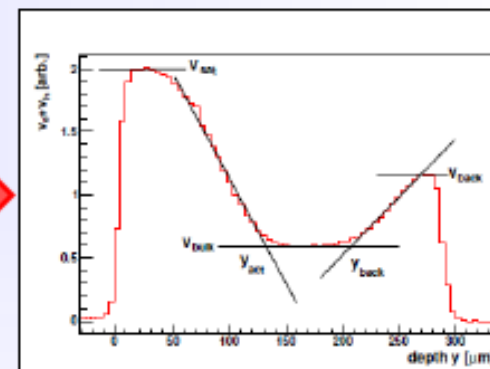
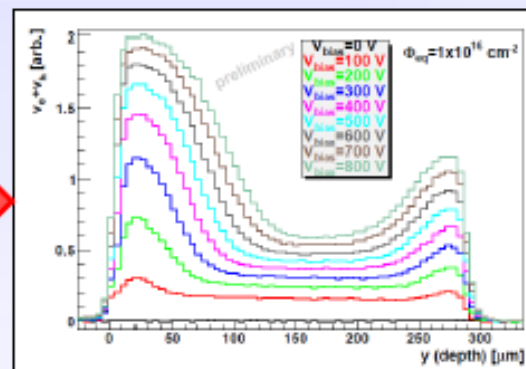
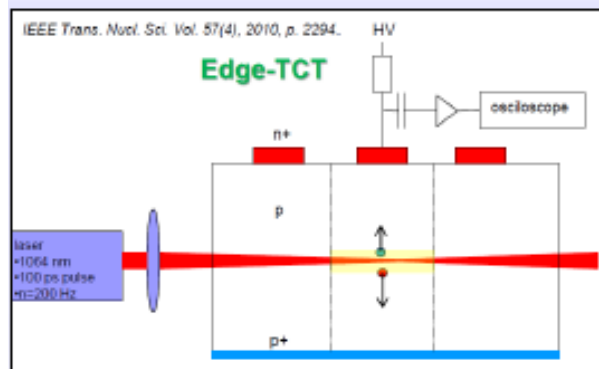
Proposed Activities for BNL:

- Establish the lab
 - Basic setup, simple characterization
 - Reproduce some results from Geneva HVCMOS v2
- Transient current technique measurements
 - Pulse a laser on the sensor to induce signal
 - The effective doping concentration and electric field are inferred from the shape of the collected signal
 - Timing of the signal is highly dependent on E-field
 - High resistivity samples have a more uniform and stronger E-field
 - Resistivity is dependent on the doping concentration
 - U. Geneva et al. is planning to produce the next version of HVCMOS for 3 different resistivities in AMS-350
 - Ideal situation to compare E-field profile and timing
 - High E-field means you collect more charge quickly at drift velocities rather than via diffusion
- Source measurements would also be very welcome

- Parameterization of electric field instead?

- Edge-TCT: Extract E-field (more precisely the drift velocity) profile and parameterize it

[G.Kramberger et al., PoS (Vertex 2012) 022]



Edge-TCT



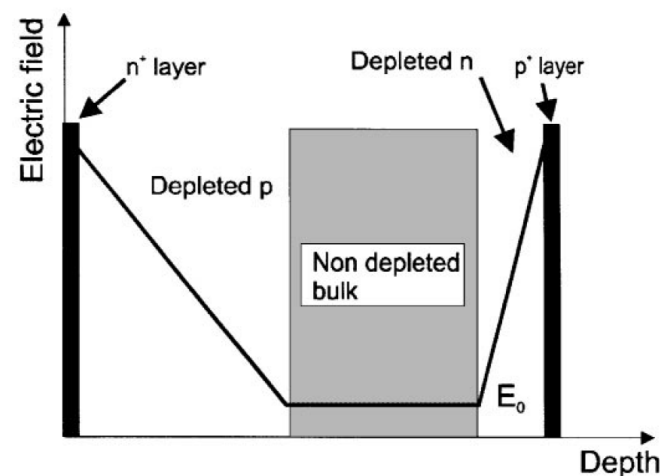
Drift velocity profile ($v_e + v_h$)



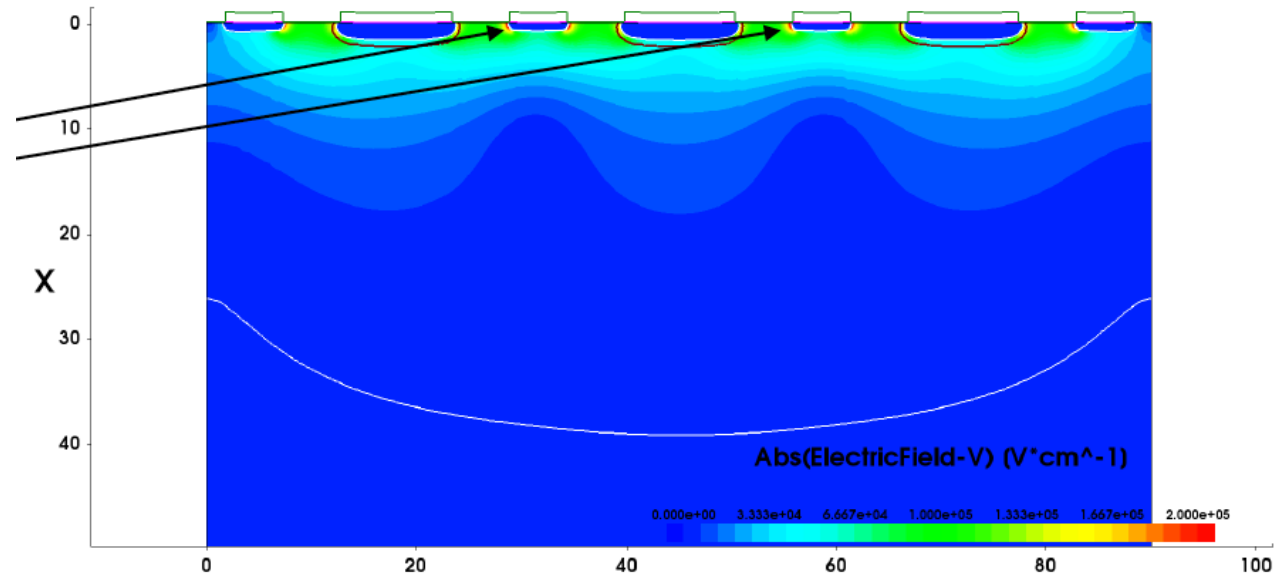
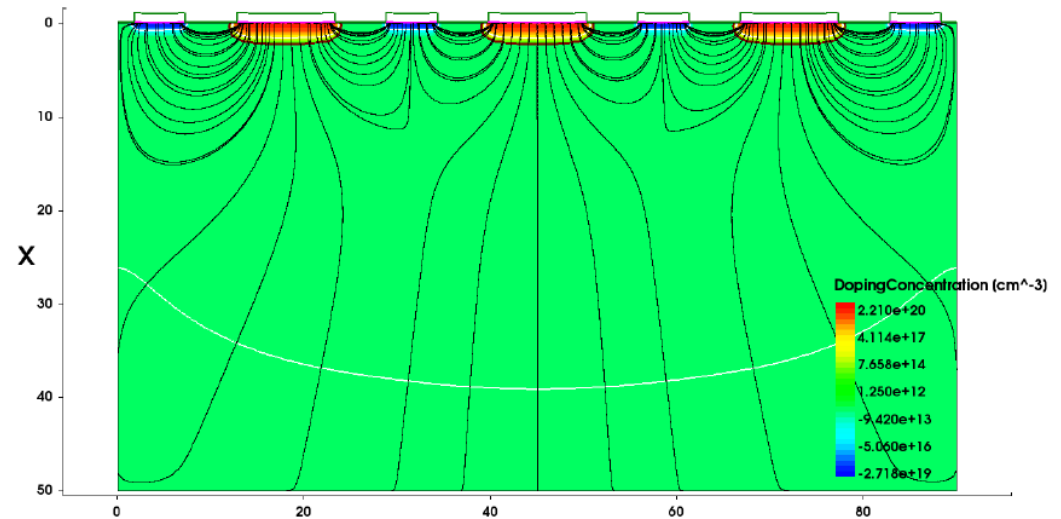
fit to extract parameters

G. Casse - FCC-hh Workshop, CERN 3-4 Jan. 2015

- Zheng Li developed TCT measurement technique at BNL
- Contacted Wei Chen—set up is still there
- May need a new laser to penetrate the HVCMOS



Simulated Electric Field Profile:



Mathew Buckland (Liverpool)
<https://indico.cern.ch/event/369680/>

BNL Lab Equipment

Probe Station

- Light tight/electrically isolated/vibration damping
- Thermal vacuum chuck
- Nitrogen flow
- Chiller (at least -6°C , preferably -20°C)
- Pico probes (~ 5)
- Microscope
- Power supplies
- Oscilloscope
- Laser
- LCR meter
- Parameter Analyzer
- Computer

-much of this equipment should already exist in the lab

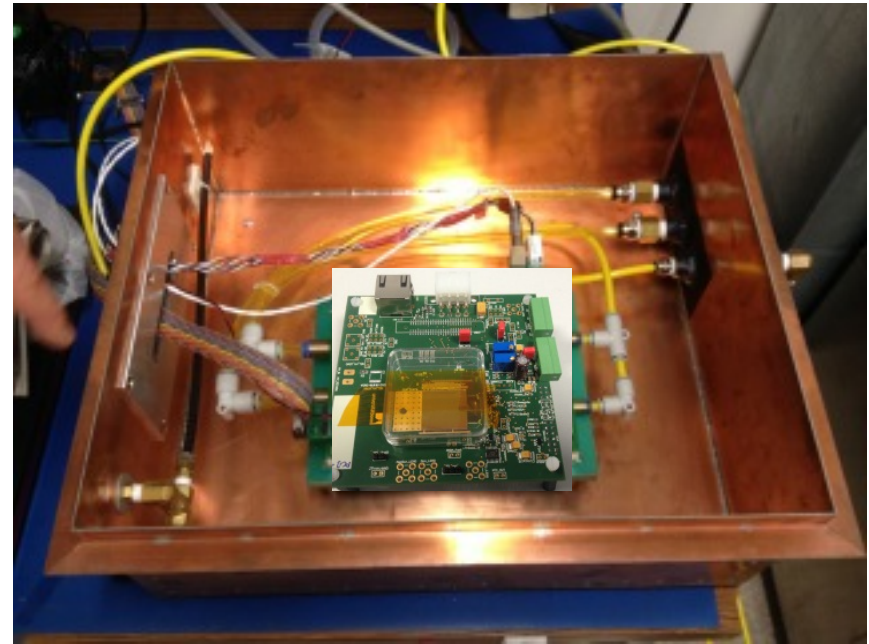


Test Bench

- Power supplies
- Oscilloscope
- Computer
- Device box—light tight, nitrogen flow, cooling

Misc. small equipment

- Cables, connectors, etc.
- Sources
- Freezer for storage after irradiation
- Thermal Chamber for annealing studies



BNL Lab Equipment

Desirable Equipment:

- Flip Chip machine for gluing/assembling small production scale -> fast turnover
- Infrared camera to debug heating/power issues
- Smart Scope
 - XYZ programmable table
 - x5000 lens

